Executive Summary

Environmental and Social Impacts of Urban Forestry in Tacoma, WA

Rachel Conway, Joanne Pham, and Veronica Weber
Faculty Advisor: James Frew, PhD
PhD Advisor: Rachel Torres
Client: PlanIT Geo™
Bren School of Environmental Science & Management,
University of California, Santa Barbara
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The Environmental Problem

Urban forests provide an array of environmental benefits - they store carbon, reduce energy, cool temperatures, conserve water, and improve physical and mental health. One of the greatest benefits trees provide is their ability to reduce air pollution by intercepting and absorbing pollutants. A single tree is capable of absorbing 120-140 pounds of particulate matter annually—all the more important to consider as 83% of the United States population lives in cities and urban settings where residents are exposed to criteria air pollutants emitted by transportation and industry. Ultra-fine particles known as PM 2.5 are especially problematic. PM2.5 enters lungs and the bloodstream and causes acute and chronic health issues such as asthma, respiratory and cardiovascular diseases and even premature death. These health impacts are also disproportionately experienced; children, seniors, communities of color, and low income households all face higher risks. Urban canopy cover is not equitably distributed across cities: low-income communities of color experiencing low tree canopy often face higher rates of health impacts compared to neighborhoods with high tree canopy. Our research project focused specifically on the City of Tacoma, where we quantified how urban trees reduce PM2.5 and mapped areas which face the greatest inequity in the city.
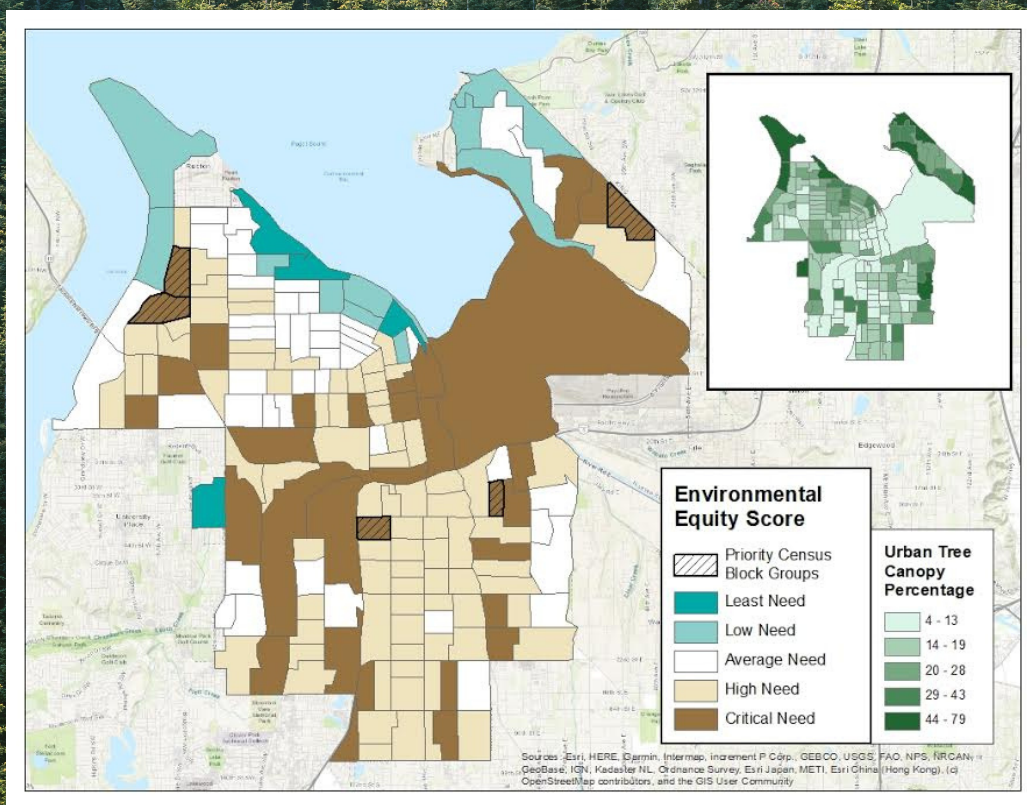
Project Approach

We developed a methodology for urban planners and community organizations throughout the Pacific Northwest to evaluate the environmental, human health, and socio-economic impacts of urban tree concentrations at neighborhood scales and consider the distributional effects across varying socio-economic regions. Our project had 3 components:

- Quantify how trees reduce PM2.5 on a neighborhood scale and their subsequent related physical/ health impacts,
- Assess where there are relatively fewer urban trees in Tacoma and how that impacts the people living in those areas.
- Develop a geospatial model to map these factors, and identify Tacoma neighborhoods which display imbalances in urban tree equity and negative environmental and health effects by developing an equity score. This model produced an equity score for each census block group, thereby allowing our client and the City of Tacoma to better inform urban forest management policy decisions.

Annual PM2.5 Removed (pounds per m2)
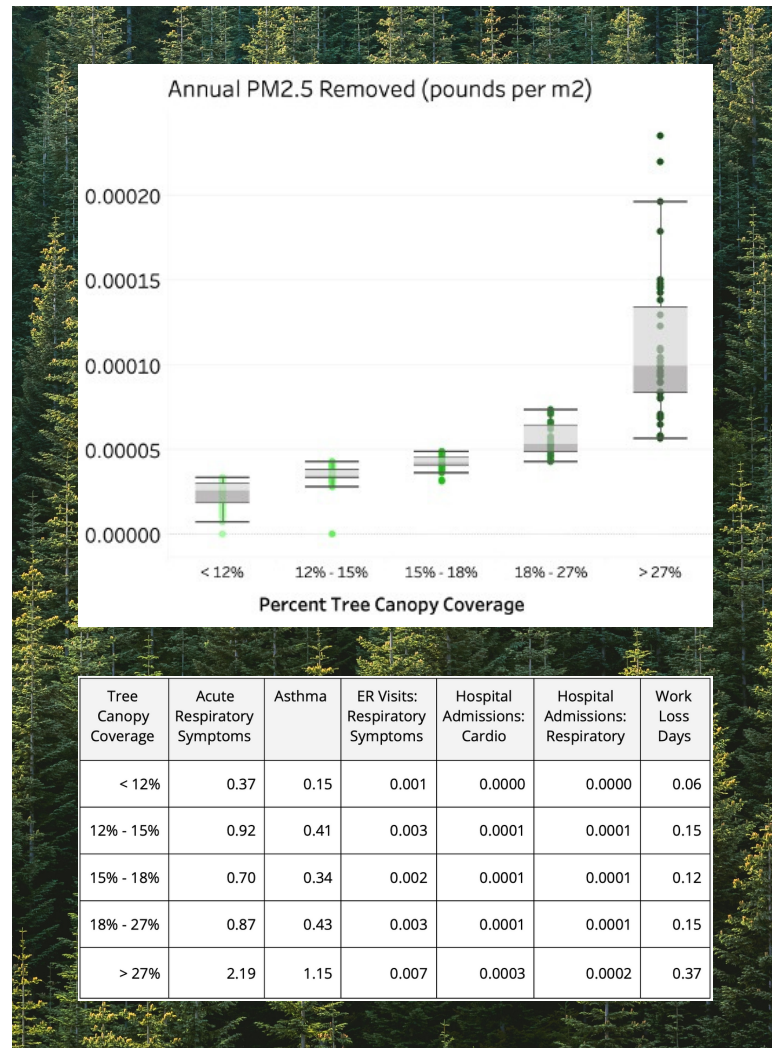
Tree Canopy Coverage	Acute Respiratory Symptoms	Asthma	ER Visits: Respiratory Symptoms	Hospital Admissions: Cardio	Hospital Admissions: Respiratory	Work Loss Days
< 12%	0.37	0.15	0.001	0.0000	0.0000	0.06
12% - 15%	0.92	0.41	0.003	0.0001	0.0001	0.15
15% - 18%	0.70	0.34	0.002	0.0001	0.0001	0.12
18% - 27%	0.87	0.43	0.003	0.0001	0.0001	0.15
> 27%	2.19	1.15	0.007	0.0003	0.0002	0.37

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From our model, we scored each census block group in Tacoma for environmental equity and identified the five highest-scoring areas with potential planting space. The Environmental Equity Score is the weighted average of five indicators: air quality, health, canopy gap, climate, and demographics. We determined that 32 out of the 172 census block groups in Tacoma had the most critical scores, 80 and above and reveal the greatest environmental equity disproportionality in Tacoma. While we initially posited that those areas should be prioritized for additional canopy coverage, we acknowledge that many of those areas do not have additional planting space. The map on the left highlights the 'Priority Census Block Groups', five census block groups with the highest Environmental Equity Score and greatest potential for tree planting interventions.

Group Findings and Recommendations

Overall, we have found that there is an unequal tree canopy distribution in Tacoma, and combined with demographic indicators, the effects correlate to overall unequal environmental equity distribution. We identified the census block groups most in need of urban forestry intervention, though we cannot determine the exact degree of inequity compared to the rest of Washington or other U.S. cities under the scope of this project. We have also determined that there is a necessity to consider urban trees in relation to air pollution and their associated health effects. As there are disparities between low tree-cover and subsequently polluted areas, there is also a disproportionate spread of health benefits. We quantified that city areas with the highest tree cover remove over 4 times more particulate matter than areas with the lowest tree cover, and these areas receive better health benefits. Areas with high tree canopy coverage experience 6 - 8 times fewer health effects such as acute respiratory symptoms, asthma attacks, hospital admissions for respiratory and cardiovascular issues, and sick days compared to city areas with the lowest canopy coverage. Urban planners and policy makers must prioritize tree plantings in areas with demographic groups who are historically at higher risk for certain diseases, in addition to in areas experiencing higher rates of air pollution as a means to combat these potential negative health effects.

In building upon our model, future clients should prioritize collaborating with local policy makers to better inform decision-making surrounding urban forestry, environmental justice, and urban development/ infrastructure. In collaborating with the Urban Forest Program Manager for the City of Tacoma Environmental Services, we have seen the potential for how wide-spanning the policy implications can be based on information provided by our tool. Our tool will have a specific impact on policies prioritizing tree plantings in low income areas, in addition to policies regarding post-planting follow up including education and ensuring that people are not displaced if/when housing prices rise. Future clients can follow in the City of Tacoma's footsteps and identify top priority areas based on the Environmental Equity Score to present to policy makers and local government officials for future urban forest management and general city planning. Cities working with PlanIT Geo™ and using our tool in the future should prioritize partnering with local social justice groups and/or city officials to ensure the prevention of gentrification after trees are planted in lower income communities of color, in addition to ensuring there is continued educational and financial support for these communities once property levels rise.